Canberra Institute of the Arts

Graduate Diploma Of Art

ANODISING : FORM IN COLOUR

Sue Hunter
January 1990

1. INTRODUCTION

My interest in colour anodised aluminium stemmed from a much earlier involvement with colour and because of the nature of aluminium any colour used with this process produced a depth, especially on a highly polished surface, that has a uniqueness to this kind of medium, I felt the need to extend what I knew into a Post Graduate year.

My first contact with anodising occurred through the work of Johannes Kuhnen. I felt he had successfully combined the medium with his work, and because of his attention to detail and finishing qualities of his pieces, the work resulted in an element of sophistication which I now strive for in my own work.

My undertaking a Post Graduate year was a direct result from my sub-major in Gold and Silversmithing that I had done previously in a Bachelor of Arts at the Canberra Institute of the Arts. I had achieved a certain standard in my sub-major that I wanted to pursue the medium further. The Post Graduate year meant a full years studying the one subject whilst attaining a higher standard of work which was more thematic and, for me, exhibition directed.

My objectives for the year were to produce a range of one-off wearable items that during the course of the year became more object like in appearance. The object had become armour-like in appearance and as the weight of the piece became heavier, whether it could be worn or not became a less important factor, only the form and colour were important. Also, because of the nature of the work, technical skills were just as relevant as the aesthetic qualities I was striving for.

1.1 Summary

The original aims of the course were to develop a one-off range of jewellery, leaning towards an exhibition style of work, which through the course of the year became object-like in appearance. The pieces were designed to follow the line of the body and have a sensual quality of line and shape. The interaction of colour was important, but during the course of the year, colour became the primary concern of the pieces.

1.2 Scope

My Post Graduate year was comprised of two predominant areas of study. The first was a colour testing program, the results of which were to be incorporated in the later pieces. The second was the development and design of six pieces which serve as the basis of this report.

1.3 Acknowledgements

My work has been influenced by a variety of sources such as the Gold of the Pharaohs Exhibition, illustrations in the National Geographic, by the environment and by other artists.

My special thanks go to Johannes Kuhnen, my supervisor, and Ragnar Hansen, head of the workshop at the Canberra Institute of the Arts. Due to their diverse areas of knowledge and abilities, the work I undertook for my Post Graduate Course had the optimum chance of succeeding.

2. BACKGROUND

During my childhood I lived overseas as well as in Australia. Germany and England when I was young and Malaysia in my early teens, as well as various parts of New South Wales, Queensland and Victoria, ending up finally in the A.C.T. As a result of this travelling and several different schools I became aware of changing environments and cultures, factors which now influence my work.

I spent my 20's attending various courses dealing with portrait painting, life drawing and ceramics. This involvement in Art helped to develop my awareness of colour and line. As a result I became fascinated with colour and colour interaction.

In 1985 I started my Bachelor of Arts at the Canberra Institute of the Arts majoring in Ceramics and sub-majoring in Gold and Silversmithing. My ceramic work dealt with line, simple form and a refined use of decorative technique and this approach followed through to my Goldsmithing. This lead to my progression from the two dimensional art of colour and line into the three dimension aspects of colour and form. My aim was to achieve a sophisticated piece of work through technique as well as through an aesthetic awareness.

My ceramic work, which was made on the wheel, resulted in a commercially viable range of items. My sub-major in Goldsmithing was also oriented towards a commercially viable product. The Goldsmithing I was doing was limited in the use of colour and greatly influenced by the range of colours and materials Johannes Kuhnen was using in his own work. Colour played only a minor role in my work at this point as the shapes of the pieces were the major concern. The pieces at this stage were all influenced by the Canberra environment.

Several examples of this influence were; one of the brooches I had made in 1988 was, in hindsight, influenced by the shape of the Corrilion, and another brooch from the logo of the Australian Post Office. An arm band was the result of the shape of one of my ceramic tools. I saw these pieces as three dimensional sketches for a further series of work.

Through the interest I had developed in anodised Aluminium I felt the need to continue on and develop a range of works that were not necessarily commercially orientated and to develop a sense of colour that would be just as important as the shapes I was to develop. I also wanted to undertake forms that were not necessarily identifiable as one-off jewellery items. I wanted to extend the skills I already had and to be able to bend large pieces of metal into a required shape. As a result I applied for the Post Graduate course at the Canberra Institute of the Arts.

3. THE POST GRADUATE YEAR

3.1 Introduction

The Basic aim of my Post Graduate year was to extend my technical comprehension of aluminium, and to embark on a colour testing program that would give me a wide palette of colours to chose from and to develop a one-off range of wearable objects which would exploit these techniques and extend my conceptual and design skills.

The first three months of the year were involved in an exhaustive colour testing program. The results to be used on the pieces that I was to develop during the year. Not only were the colours important but the colour fastness of the colours that were developed was a crucial concern.

My pieces evolved from a body ornament concept, to take on an armour like appearance and upon reflection appear to have their origins from protective clothing of Roman times. Articles in the National Geographic and exhibitions such as the Gold of the Pharaohs had direct bearing on my work. The imagery in the National Geographic would re-appear in my work as can be seen in Piece No 1 and, previous to this year, the lustre effects on my ceramic work were a direct result of a picture of a sun setting on the Rio-Grande. The Gold of the Pharaohs Exhibition and in particular a gold choker, resulted in some of my more recent neck pieces.

The work in my first three pieces resulted in a simplification of shape and line. This had its origins from my admiration of the work of Brancusi, namely the Birds in Space series, and Henry Moore and the Reclining Women series. Their use of simplicity to create a pure form devoid of any unnecessary detail became an important element in my work. Line, as a design element, is kept to a minimum, the surplus being removed, making the eye and the imagination do the work of exploring the shapes and discovering the form without all the answers being made obvious.

Their work has been more relevant to mine than people such as Barbara Hepworth and Isamu Noguchi whom I have since studied, as Brancusi and Moore use a far more sensual quality of line. This sensual use of line has a softening effect on the type of work I am doing. The aluminium appears softer and the flowing use of line helps the pieces to appear to mould and blend in with the line of the body.

All the pieces to date have resulted in a much freer use of colour and line. As they became larger, the interaction and interplay of colour had more impact and focal qualities on the work. As the colour combination became bolder, the colour lost in complementary position as in the first pieces to become an equally important and sometimes the more dominant feature of the work.

By accident the work took on a breast plate appearance and was no longer identifiable as a piece of one-off jewellery. It became a sculptural object to observe rather than something to be considered for its wearable properties.

3.2 The Colour Testing Program

The colour testing program was a controlled series of testing inorganic dye colours in varying strengths and mixes on aluminium tiles to obtain a range of colours suitable for the pieces to be designed during the Post Graduate year.

The controls for the colour testing were that the pieces of aluminium would be dyed in colour baths heated to 60 degrees Celsius, the pieces would be dyed for at least 7 minutes for the full concentration of the dye, that the pieces would be anodised in the sulphuric bath between 18 and 20 degrees Celsius and anodising for 60 minutes at 15 volts, then after colouring be sealed in steam for 60 minutes.

For economic reasons the dye mixes were made up of 4 grams of coloured powder to 1 litre of distilled water. The single colour was made from 8 grams of coloured powder to 1 litre of distilled water, to 0.25 grams of coloured powder to 1 litre of distilled water.

These results were used as the basis for the pieces made during the year. They resulted in a broad palette of colours that meant any combination of colour was possible for a single piece of work.

The resultant tiles from the colour testing program are shown on the next page.

Photo 1. Tiles created in the Colour Testing Program

3.3 Piece 1 - The Empire State.

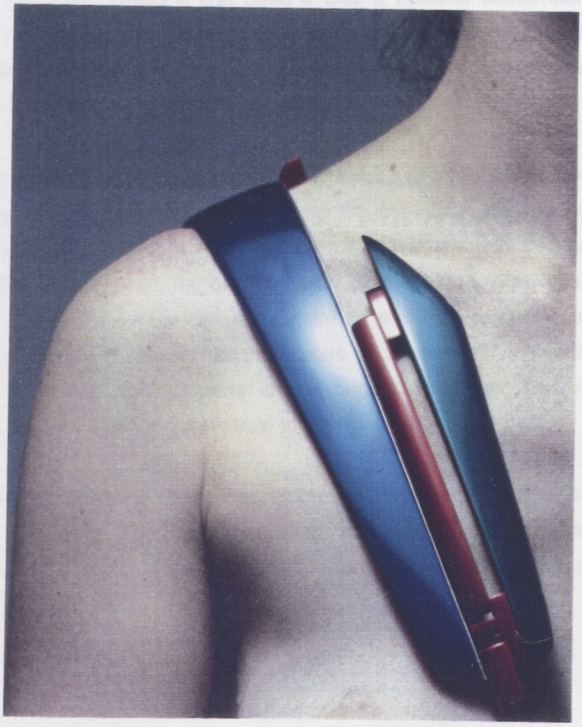
The first piece is a shoulder piece. The design originated from an article in the National Geographic on skyscrapers. Through a fear of heights and several dreams on the subject I decided that this was the theme to start my Post Graduate year. The elements of line were extremely important to the piece and at that stage, colour was a secondary consideration. I still at this point had not linked the two elements of design and colour together.

The piece was also a technical learning process of how to satisfactorily connect the separate elements of the piece together. The solution was very long two millimeter wide screws. I also felt it necessary to incorporate a piece of precious metal into the design. At this stage, tradition still had a great deal of bearing on my approach to gold and silversmithing. I felt the piece would be inadequate if it was only made out of aluminium.

3.3.1 Piece 1 Description.

The large piece of aluminium following the contour of the shoulder is related to the main core of the skyscraper, from which the smaller line element were attached, similar to the concept of cantilevering. The colour blue I chose because of its safe appearance from which the more decorative and colourful elements were sprung.

Photo 2. Piece 1 - The Empire State



3.4 Piece 2 - Untitled.

The next piece was a turning point in my approach to designing my work. Through the Gold of the Pharaohs Exhibition and from seeing a wide gold choker on exhibition, the idea of using a series of paper cut-outs from large pieces of paper became the basis for my work. When I had arrived at a satisfactory conclusion I would wear a lump of metal around my neck, shape it and bend it until it became comfortable for me to wear. Comfort is an important factor in my work and an equally important problem to solve for all the pieces. Each piece I made is designed to only fit me due to the variation in shoulder shape and size from person to person.

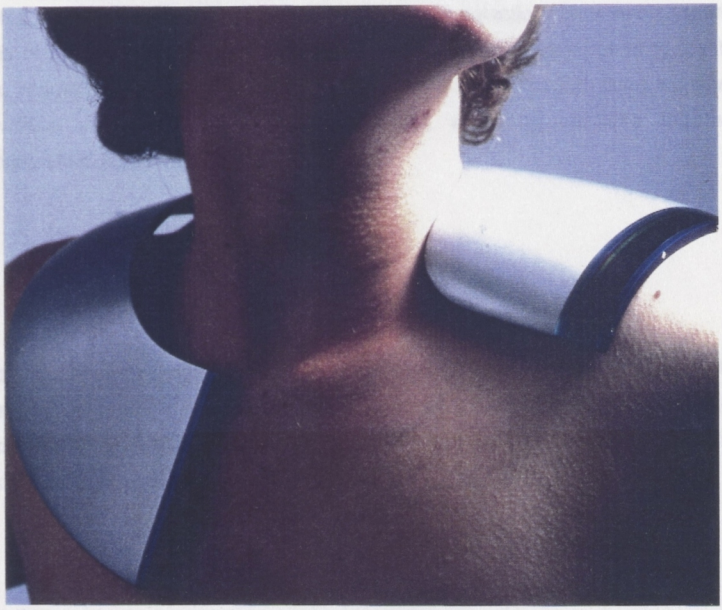
Once the bent shape was comfortable for me to wear the coloured line sections of the piece were then fitted. Again long screws were the answer to the structural problem. The most time consuming of all these processes was the actual finishing of the piece. Filing, emerying and polishing the piece was an exacting task. This took me days to complete as I had to use thick pieces of metal so that I could satisfactorily join the pieces of metal together. Except for the places of attachment, the metal would be removed to, in some cases, a quarter of the original thickness. This lightened the piece enough for it to become comfortable to wear.

Again, this working method meant that, colour decisions were arrived at the end of the process. Through re-anodising the elements concerned could be changed after the initial colouring of the piece. The colour testing process was still being carried out at this point in time.

3.4.1 Piece 2 Description.

This piece was influenced by a large Egyptian collar in the Gold of the Pharaohs Exhibition. The thin lines of colour were used as a reflection of the Egyptian paste used in the making of jewellery style objects. The expanse of aluminium left silver was used in reminiscence of the large amounts of precious metal used by the Egyptians.

Photo 3. Piece 2 - Untitled



3.5 Piece 3 - Untitled.

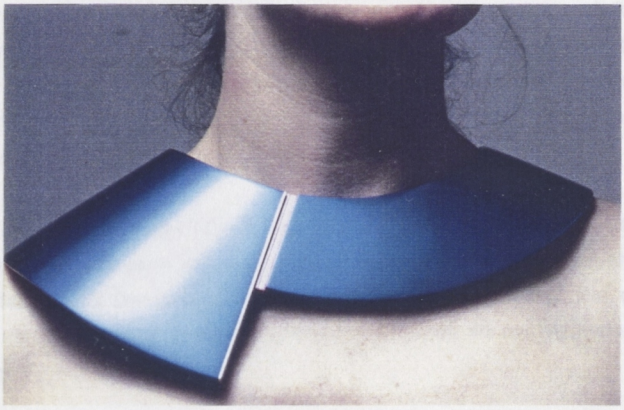
The third piece resulted from a quick sketch blown up into a large paper cut out. The advantage of making a large paper cut out meant that the basic shape of the piece could be worn and altered before the cutting of the aluminium. Once the aluminium was cut the next step involved joining the two pieces of aluminium by way of milling out sections of the metal and then screwing a metal plate into position. I had given up the time consuming task of making my own screws and turned to a commercial source for them.

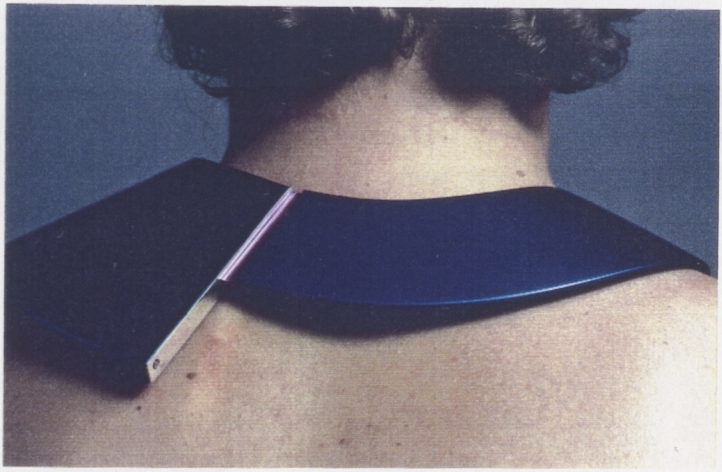
At this stage my choice of colour was still safe in selection. Blue was chosen as the basis of the piece for its cool, solid appearance. An easy background to highlight the pink, mauve and purple line sections. The three pieces to this point were technical exercises in learning how to bend metal, attaching sections together and incorporating colour into them.

3.5.1 Piece 3 Description.

Two large pieces of metal were used so the space between them could be highlighted. This was done with the aid of recessed coloured lines and a long strip of silver. This piece was a result of a quick sketch of shapes that were connected in the back of the piece. Not as Egyptian oriented as Piece No 2.

Photo 4. Piece 3 - Untitled





3.6 Piece 4 - The Start of Rome.

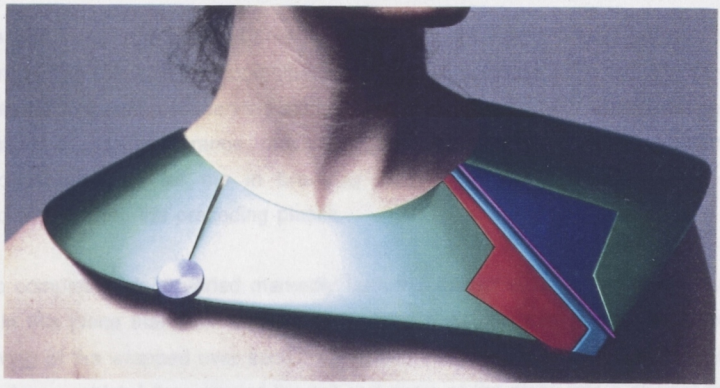
Piece 4 took on bolder proportions. It had become important for me to have the metal encompass the neck as it was the next obvious step from the open neck forms I had been making. Technically a harder exercise, but for aesthetic reasons the results were more rewarding. The decorative use of line was replaced with shapes that were fitted into the piece, resulting in a more dynamic play of colours. The colours I chose took on a more focal quality than in the previous pieces.

At this point, the work had lost its identification with jewellery and instead had become an object or a piece of armour. The sensual use of line was still an extremely important factor and the interplay of shapes became the priority. The colour was chosen in the early stages of the piece and had become an equally important factor when designing the work.

3.6.1 Piece 4 Description.

This piece took on the dimensions of a Roman breast plate. Its armour like appearance was a break away from the previous pieces. Larger sections of colour were used so as to highlight the interactions of colour. The sections of colour became an integral part of the piece and not just a decorative element. This piece was as a result of further development of the concept of wearable items becoming more object like in appearance.

Photo 5. Piece 4 - The Start of Rome



3.7 Piece 5 - For Ragnar, colour.

Piece No. 5 was designed as an extension of Piece 4 in that it was wrapped around the neck but the cross over point was placed at the front. The pieces had become larger, resulting in a freer movement of line. Shapes were again incorporated into the piece but the streamlining of the piece was altered by the jutting out of the triangular pieces of aluminium . This jutting out quality helped to highlight the smaller sections of colour.

The colours chosen had lost their harmonious qualities and instead became the focal point of the piece. It is a combination of opposing colours with the aim of creating some form of unity between the starkness of the yellow and the warmth of the smaller sections of pink and orange, resulting in an impact of colours for the viewer. It was also an exercise for me in breaking away from the safeness of the colours incorporated into the preceding pieces.

The completed piece varied markedly from the design stage to the final result, more so in this piece than others. Serendipity always plays a role in my work. The gentle curving of the wrapped over sections was due to some not too exacting cutting on the band saw, which I then altered the tail end curve of the piece into a straight line.

3.7.1 Piece 5 Description.

The qualities of the breast plate style of armour were epitomized in this piece. The elements of colour had become the dominant feature of the work. This piece resulted in a masculine like appearance, more so than the previous pieces and the choice of colour influenced this decision. Very Roman like in result and at this point very influenced by armour of Roman times.

Photo 6. Piece 5 - For Ragnar, colour

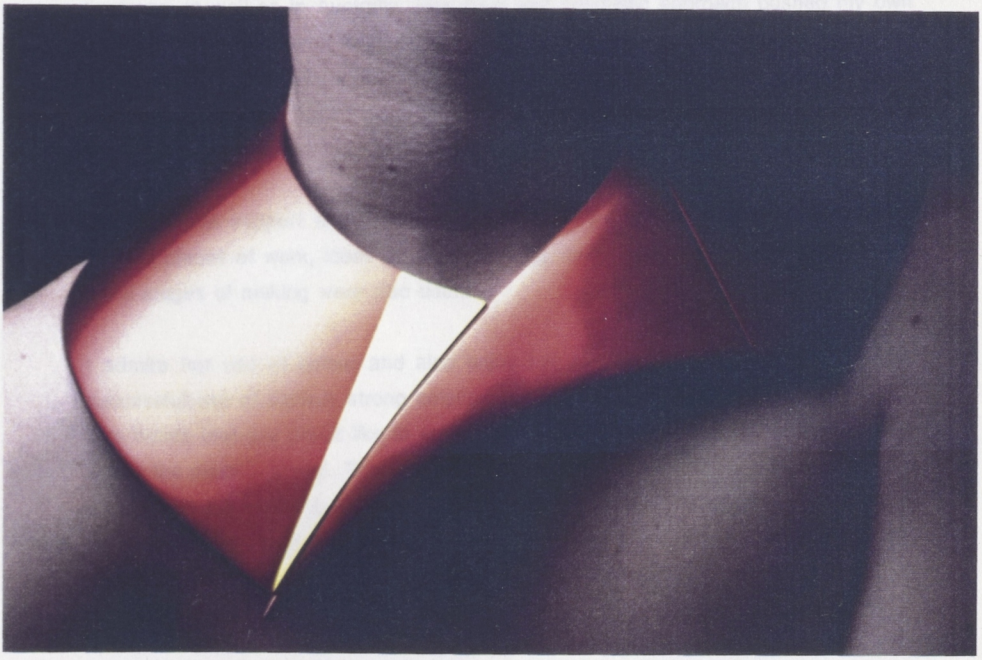
3.8 Piece 6 - Moi.

Piece 6 was one step further from the previous pieces as it resulted in a single curve around the neck. The excess of the wrapped over aluminium was removed. The colours chosen were warmer as a reaction to the cool starkness of the yellow piece. I felt this resulted in a more feminine piece of work. The opposing curving on the front of the piece, sections being fitted into the piece, and a flowing use of line reflected the qualities I liked of the preceding pieces.

3.8.1 Piece 6 Description.

The culmination of the preceding pieces especially the negative and positive curves of the piece. Small amounts of colour used again to interplay with the dominant colour. The object of the piece being to be able to encompass the whole neck without tail ends of metal overlapping.

Photo 7. Piece 6 - Moi



3.9 Consultancy

During the course of the year, Susan Cohn acted as a consultant for my work. She is prominent in her field for anodising a range of objects from wearable items to shallow bowls. I gained knowledge of her technical expertise as well as her ideas on self promotion in the market place.

Currently the owner of the Workshop 3000 in Melbourne, she has promoted herself overseas as well as in Australia. Her drive and optimistic approach pushed my own incentive to do well, even further. She re-enforced ideas that had been instilled in me by the Gold and Silversmithing Workshop, such as the importance of good photography, well designed business cards , etc, and generally, how to successfully tackle the market place.

Her technical support and advice in areas such as fastening devices for difficult shaped pieces of work, ideas on colour dyeing, and approaches to aluminium in the initial stages of making were also useful.

I admire her use of colour and also enjoy her strong but simple shapes with her successful use of various strong colour combinations on a single piece. Notably the arm bands that are donut like in appearance with frills of aluminium around the rim where the piece is joined. That she has also stretched the boundaries of what is to be considered the usual guide-lines and definitions of jewellery resulting in her work becoming more of an object. It is at this point that I find her work more stimulating and find some correlation between our work.

4. WORKING METHOD

Serendipity plays an important role in my work. Any line accidentally cut, a piece of metal not yet removed, is considered. So the actual piece that has been conceived in the design process can sometimes evolve into something considerably different in the final stages. Filing the final shape is usually determined at the time when I am shaping the piece. Sometimes it just feels right to file one direction instead of the other. Each piece is first designed on paper. Then, because of the thickness of aluminium I require and the grade of aluminium I need (which is only available in long strips 4 meters in length, 160 millimeters in width, and 6 millimeters in thickness), the design is divided into sections. From two to four sections are required, which are then cut up and methods are devised on how to join them together.

Before joining the pieces together they are bent in a vice, with the aid of a thick piece of pipe and a hollowed out curve in a piece of wood. The basic shape is formed. If a double curve is required it is hammered into place over a hollow section on a tree stump.

The sections are then cut and filed to fit one another. Hinging devices are put in place at this stage. Then the pieces may need to be milled, as in the case of two large pieces of aluminium that can be connected in this manner. A metal plate is devised for the milled out sections through which small screws hold the two or more sections together from the underside of the piece.

Once all the sections are joined together, by either milling, screwing, various hinging methods, the piece is then shaped on a belt sander to remove the excess aluminium. Once that has been accomplished the pieces are filed with a large course, single cut file or a panel beaters file.

The final stages are the fine filing of the whole piece to remove any large indentations caused by the larger file and belt sander. Then the piece is emeryed with course emery paper, finishing off with a much finer grade of paper.

The underside of the piece is usually sandblasted. there are two reasons for this. First is convenience, it is easier to sandblast than to polish the underside, and secondly aesthetic qualities. The colours used on the anodised surfaces give a different impact and hue on a sandblasted surface than they do to the highly polished finish I use on the upper side.

The underside of the piece is then covered in masking tape, so as not to scratch the surface accidentally when polishing the outer surface of the piece. The top side is either polished in sections or altogether depending on whether there are any protruding sections.

The sections of the piece are then stripped for a few minutes in a diluted bath of caustic soda (150 gms/litre), rinsed, then neutralised in a diluted bath of nitric acid (20% volume). This is an important stage in the anodising process as the points of contact are cleaned so that in the final bath in which the pieces are anodised, the electrical current can freely pass through the piece.

The anodising process is best explained by :

> 'Anodising is an industrial process that produces a stable oxide film on the surface of aluminium. The work piece is attached to an aluminium hook or wire and then immersed in an acid bath (electrolyte solution). It receives the positive (anodic) current, and as oxygen is released and oxide film containing billions of pores similar to that of a honeycomb structure is produced on the metal surface. These pores will then accept dye. Once sealed, the metal is strengthened and protected from corrosion and is resistant to water, oil, salt, weather and general wear'
>
> Tisdale, David, "Anodizing Aluminum", Metalsmith, Spring 1985, p.33

Once the points of contact are cleaned, aluminium wire is attached to the individual pieces by various methods such as tension, screwing the wire into a hole specially made for the purpose of attaching the wire to the piece, screwing attachments onto the piece for stability reasons etc. Once the wire is firmly in place the piece is then secured onto an aluminium or copper rod. The piece is then stripped again in a caustic bath, rinsed and then neutralised in a diluted bath of nitric acid, rinsed again. To ensure a uniform coating thickness appearance of the anodised layer, oil, dirt and other foreign matter has to be removed. The piece is then placed in a bath of diluted sulphuric acid (20% volume) through which an electric current is passed.

The aluminium or copper rod to which the piece is secured, is then connected to the rectifier through which the positive current is passed. The negative current from the rectifier is connected to a lead sheet (cathode) that is already in the bath of sulphuric acid.

A voltage of 15 volts is then applied and the piece is left in this bath for 60 minutes, with the temperature of the bath regulated to between 18 and 20 degrees Celsius. During this time a steamer in which the piece will be placed after the colouring stage is turned on. The steam seals the surface of the metal after the process of anodising and colouring has taken place. If the piece is not sealed, the coating on the piece easily stains, colour will leach out easily from the surface and the surface is less corrosive resistant. By sealing the surface the dyes have the optimum chance of lightfastness and permanence.

The dye is then heated to 60 degrees Celsius. The anodised piece can be coloured in cold dyes that are at room temperature. Susan Cohn, uses a black dye at room temperature for some of her pieces. She felt she obtained a depth of colour not possible at other temperatures. I have used dyes above 60 degrees when the resulting colour at the lower temperature wasn't strong enough. My conclusion being that the temperature of the dye can be varied depending on what result is required on the piece. Some of the colours alter to different colours when heated above 60 degrees.

The Sandoz Company is the main source in Australia for inorganic dyes. Inorganic dyes are preferable to organic dyes, as organic dyes are generally inferior to inorganic dyes in lightfastness. A wide range of organic dyes, such as clothing dyes, are available and can be reasonably successful if they are not subjected to prolonged exposure to sunlight or weather.

After the piece has been in the anodising bath for 60 minutes exactly, the piece is rinsed in cool to warm water to remove any acid left on the work. It is then placed in the dye bath. If using a dye bath of 60 degrees the maximum strength of the dye is reached within seven minutes. It is advisable to dye the piece for this time period so as to prevent fading of the colour after the piece has been assembled and completed.

After the dye bath, the piece is then suspended in the steamer for at least one hour to seal the surface of the aluminium. then it is removed, then rinsed so as to avoid and steam marks and then the piece is completed. The sections of the piece are then assembled together and a finishing coat of wax, such as floor polish, is applied to the finished piece to give it an extra sheen.

The colours I use in my work are as a direct result of colour mixing and using different strengths of the dye. A strong dye is normally obtained by using eight grams of coloured powder to one litre of distilled water. The stronger the dye the more colour fast it is. Distilled water is used so as to avoid any contaminants in tap water such as iron that may cause discolouration of the piece when it is being dyed and also to prevent any attack of an impurity on the colour dye mix.

My test pieces were dyed in strengths of colour ranging from eight grams down to a quarter of a gram of powder per litre of water. The colours I mixed were with dyes made from four grams of powder per litre of water for economic reasons and also to be consistent in my results.

One of the major considerations in colour anodising is making sure the PH balance of the dye bath is 5.5. The acidity or alkalinity of the dye is adjusted with either ammonia or vinegar. Up to the point the PH meter was acquired, major pieces of work had to be re-anodised three to four times, which meant stripping the piece of work completely in caustic soda and starting again from the beginning of the process. It was not realised the importance of this piece of equipment until after it had been acquired.

The problems encountered before the acquisition of the PH meter included, shallow depth of colour, an unevenness of colour coating and dull to chalky dyeing which meant colour could be wiped off.

Aluminium comes in different grades. The most suitable for anodising in Australia is 5005 of the series 5000, which is aluminium with magnesium as the alloy, or 6063 of the series 6000 with magnesium and silicon as alloys. These two aluminium products give consistent results. They are easier to re-anodise and the problems entailed are far less than when using aluminium machining bar. Machining bar has a tendency to corrode more easily resulting in deep black pits in the finished piece. Series 1000, which is ninety nine percent aluminium is also satisfactory but it has the disadvantage of being much softer and therefore more prone to wear.

5. SUMMARY

My objective of the course was to develop a range of one-off wearable jewellery pieces. During the course of the year these pieces became object like in appearance, similar to a piece of armour from Roman times.

The use of colour enhanced the pieces making them more object like in appearance. Through my love of colour and the interaction of colour, aluminium and colour anodising became the obvious choice. The anodised colours I felt produced a depth of colour and uniqueness to this kind of medium.

The six pieces of work were designed on paper, made to fit the neck comfortably and then the idea was transferred to the aluminium which was cut out into sections and attached by various methods such as screws, and milled out sections. From there the piece was filed and emeryed into shape and then finally being anodised and coloured.

6. BIBLIOGRAPHY

Anderson, Patricia, Contempory Jewellery, Millennium, Newton NSW , 1988

The Aluminium Development Council, Aluminium Technology, Sydney NSW

Tisdale, David, "Anodizing Aluminum", Metalsmith, Spring 1985, p.27-29

Jensen, Marvin, "Color, color, color more on Aluminium & Aluminium Anodizing", Metalsmith, Fall 1986, p.33-35

7. **APPENDIX A** - Work Proposal

My objectives for the Post Graduate course are as follows :

1. I am to do a lengthy exploration into shapes that can eventually lead to designs for wearable items. These shapes will be developed by systematic research of a series of similar pieces of work. The materials used will be a range from aluminium to precious metals such as silver; aluminium being appropriate for the use of colour.

2. I wish to explore colour; to document the results of colour tests on aluminium for a body of work to be designed from the exploration of shapes, the colours developed having the possibility of being used singularly or in combination.